Program title: Food Innovation and Product Design

Module Title: Advanced Molecular Gastronomy

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Assignment type: Academic Report

Assignment Title: Note-by-Note version of Caprese salad

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Introduction

Note by Note cooking (NbN) was introduced to the world in 1994, by Herve This, a French physical chemist. It is a method of molecular gastronomy that includes preparing dishes with chemical compounds, either pure or mixtures, rather than typical culinary ingredients. This technique has the ability to contribute to the creation of customized foods and drinks, for example, by using sustainable and nutritionally valuable ingredients *(Burke et. al, 2020).*

In the recent decades, a global energy crisis has been steadily increasing, especially with the inflation recent surge. Different markets face their own particular challenges, but high energy prices, strong consumer demand and supply chain disruption mean that inflation is a global problem *(Mintel group Insight, 2022).* Up to 80 percent of the total energy used during traditional cooking methods is wasted *(This, 2014).* H.This argues that cooking with molecular compounds will be significantly more energy efficient and environmentally friendly than traditional cooking procedures. NbN has the potential to enhance the health advantages of so-called natural foods by adding unadulterated nutritional content to a wide range of dishes.

However some bottlenecks in the widespread of this technique are mentioned in his book particularly regarding: regulation by the competent authorities in food safety, social acceptance genuineness and wholesomeness of the new dishes *(This, 2014).* Neophobia is one of the main challenges when it comes to social acceptance. Food neophobia is generally regarded as the reluctance to eat, or the avoidance of, new foods *(Dovey et. al, 2008).* This behaviour is part of "omnivore's paradox", a concept firstly introduced by Rozin and later developed by Fischler in 1988 which describes the human relations with food. It expresses the ongoing conflict people confront when choosing their diet: on the one hand, a desire for nutritional variety and new sensations, and on the other hand, extreme caution and occasionally repulsion towards new and unexpected foods. While humans, as omnivores, rely on diversification and exploration to receive all the nutrients they require, they must also be cautious in their food choices to avoid eating dangerous compounds. People are in a pendulum between food neophobia and food neophilia *(Lin-Hi et. al,2022).*

Based on this reason, many projects that produce NbN dishes are inspired by a traditional dish in order to overcome neophobia of the reluctant consumers, as has been noticed in previous TU Dublin assignments of Advanced Molecular Gastronomy module *(Burke et. al, 2020).* In continuation of this trend, in this

project a traditional Italian dish like Insalata Caprese (Caprese salad) was chosen to be the source of inspiration and development in a NbN format.

Aim of the assignment

In light of the 10th annual international contest for Note-by-Note cooking, the aim of this assignment is to present the development of a well-known dish such as Caprese salad in a Note-by-note cooking version and assess its acceptability by comparing the final dish with the expectations prior to the experiments. The final dish should include savoury dices and fibers as it is the main theme of the annual contest being held in Paris, France in September 2022.

Materials and methods

Caprese salad is a typical summer salad originated in the island of Capri, Italy. It is a very simple dish which can be prepared in 10minutes. There exist some variations of the dish, but it generally consists of three main ingredients: 3-4 ripe medium-sized tomatoes, 1 ball of fresh mozzarella cheese and 5-6 fresh basil leaves. Additional optional ingredients include: extra virgin olive oil, balsamic vinegar, sea salt, black pepper, mint leaves *(Elkus, 2019).* The recipe preparation for 4 servings has the following instructions:

1. Slice the tomatoes and fresh mozzarella into 1cm thick rounds.
2. Place the tomatoes and mozzarella on the plate in an alternating pattern.
3. Scatter the basil leaves on top of tomatoes and mozzarella.
4. Season with salt and black pepper.
5. Sprinkle extra virgin olive oil and balsamic vinegar on top of the dish.

The nutritional content of the salad is: 320 calories, 24g fat (7g saturated fat), 14g carbohydrate (11g sugars), 1g fiber, 9g protein, 161mg sodium *(CarbManager websitem 2022)*

Fig.1 A typical Caprese salad Source: Getty images

In order to replicate this recipe in a NbN version, in total 13 trials were conducted in a span of four weeks of experiments. Five ingredients were the replicating target, namely: mozzarella cheese, tomato, basil, balsamic vinegar, olive oil. Various hydrocolloids, powders, flavors, and food colorings were used in these trials.

Ingredients

The molecular ingredients and flavors were manufactured by ‘Sosa’, a Spanish leading company of premium ingredients. Water and salt were available in the TU Dublin kitchen. The food colorants were produced from ‘Cake Decoration’. The ingredients used in the final dish included the following: 500ml water, 500ml vegetable oil, 250ml balsamic vinegar, 30g skimmed milk powder, 25g tomato powder, 10g isomalt, 10g agar-agar, 10g dietary fiber, 5g salt, 5g kappa carrageenan, red and green food colorants, tomato flavor, basil flavor.

Fig. 2 & 3

Ingredients used for the preparation of recipes

Equipment

The kitchen utensils used were provided by the TU Dublin LG-06 kitchen class. These utensils included: stainless steel pots, two stainless steel mixing bowls, plastic containers for ingredients, one medium-size French whisk with stainless steel strands, tall plastic container, kitchen knife, tablespoon. Other specific equipments used were carton forms in shapes of rectangular and trapezoidal prism, syringe, squeeze bottle, slotted spoon, food thermometer. Some large kitchen equipments used included: “Fisherbrand” precision weighing scale, “L. TELLIER” hand-blender, “Electrolux” gas stove, “SAGI” freezer.

Fig.4 Utensils used in the recipes preparation

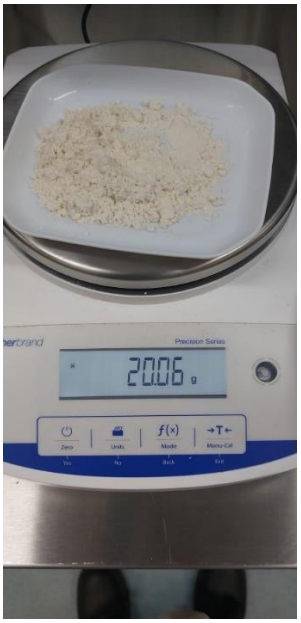

Fig.5 Precision weighing scale

Recipes

Five final recipes were prepared for the components of the final dish. They were made in a consecutive manner. The ingredient amounts and instructions for their preparation are as follows:

1) **Tomato agar gels**: 200ml water, 5g tomato powder, 3g dietary fiber, 3g salt, 2g agar, two drops of red food colorant (approx. 1ml), one drop of ripe tomato flavor "Sosa"

- All the ingredients were weighed and then mixed in a bowl with a whisker until a homogeneous mixture was achieved. The mixture was poured in a pan and brought to a boil. It was continuously stirred for 2minutes then removed from the gas hob. After letting it cool down for a few seconds it was put in the form and put in the freezer for 20 minutes at -20°C.
  The source for this recipe was a class lecture of this module (Molecular Gastronomy Lecture 2 on Agar, Maltodextrin, Methylcellulose and Xanthan Gum, 2022).

Fig. 6 "Tomato" agar mixture being heated

2) **Mozzarella balls (reverse spherification):** 150ml water, 30g skimmered milk powder, 3.7g calcium lactate, 1.8g kappa carrageenan; 500ml water, 2.5g sodium alginate

- Water and milk powder were added in a bowl and whisked until milk was achieved. Calcium lactate and kappa carrageenan were added and the mixture was whisked for 20seconds. In a separate bowl water and sodium alginate were added to make an alginate bath. It was blended with a hand blender for

30seconds. This mixture was poured in a food-graded polyethylene bag which was put in the vacuum machine to remove the air bubbles in the mixture because they can interfere with the spherification process. After vacuuming for 1minute, the mixture was poured in a clean bowl. Another bowl was filled with plain tap water. With the help of a spoon, the “milk” mixture was poured in the alginate bath where it was gently stirred and left for 4minutes to gellify. 3 spheres were obtained. Afterwards the spheres were immediately put in the bowl containing tap water to stop the gellification.

The inspiration for this recipe came from a collection of Molecular Gastronomy recipes using hydrocolloids *(pg.82-83, Lersch, 2014).*

Fig.7 Milk mixture being whisked

3) **Mozzarella gel dome:**

- The remaining part of the “milk mixture” was mixed with 1g agar and poured in a pan, then brought to a boil for 1min. After letting it cool down for a few seconds it was put in the prism form and refrigerated for 25 minutes at 3.2°C.

4) **Balsamic vinegar spheres (frozen spherification):**

500ml of neutral vegetable oil was put in the freezer at -18°C for 2hours. 200ml balsamic vinegar was mixed with 50ml water. 2g agar-agar was added and the mixture was whisked. Then it was poured in a pan and brought to boil for 1minute. Afterwards the mixture was left aside to cool. The oil was taken out of

the freezer. With the help of a syringe, the vinegar mixture was streamed in droplets into the cold oil. The droplets started forming spheres and after 1min they were strained out of the oil using a slotted spoon.

This recipe is from the pg.16-17 Master unit 1 Alginate and agar, Advanced Molecular Gastronomy module, 2022.

Fig. 8 Vinegar spheres in oil

5) **Encapsulated olive oil:** 15g isomalt, 10ml olive oil, 5ml water

- Isomalt was mixed in a pot with a small quantity of water, enough until it looked like wet sand. It was heated on medium-low heat until it started to bubble. The mixture was removed from the gas hob and set aside to cool. The olive oil was poured in a squeeze bottle. The isomalt on the bottle was measured with a thermometer and when it reached 140°C, a round metal cutter was dipped in the pot. A thin layer of isomalt was formed around the mold base and on top of this base olive oil was poured by using the squeeze bottle. The olive oil drops down encapsulated by the thin layer of isomalt. This recipe is inspired from a Yotube video *(Chef Studio "Encapsulated olive oil", 2020).*

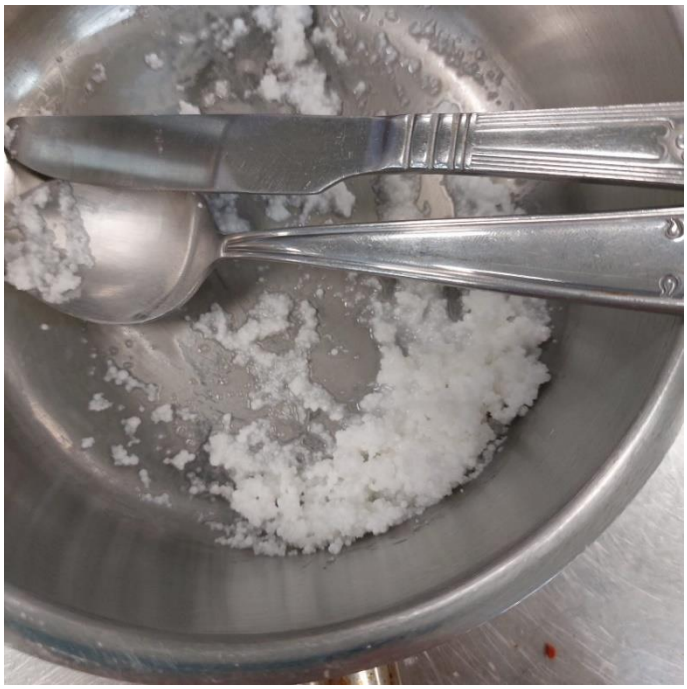
Fig. 9 Isomalt mixed with water

Results

The tomato agar gel was firm and stable showing good consistency. It had a bright red color with a smooth surface and a delicate mouthfeel. The taste was good according to the students who tried the sample. After cutting it in small cubes of 1x1x1 cm it was plated in a round shape in the dish.


Fig.10 “Tomato” gel after the freezer

The mozzarella balls took the largest amount of time to prepare among the ingredients of the plate. The final product was too thin, and it became liquidly soon after being placed on the plate. The membrane that encircled the liquid was insufficiently strong. The spheres had a semi-translucent pale white color.

As the central part of the plate, the mozzarella gel dome turned out stiff and thick. It was obviously more viscous that the tomato gel, but it was fairly chewy. The dome had an even and uniform texture. It had an opaque white color.

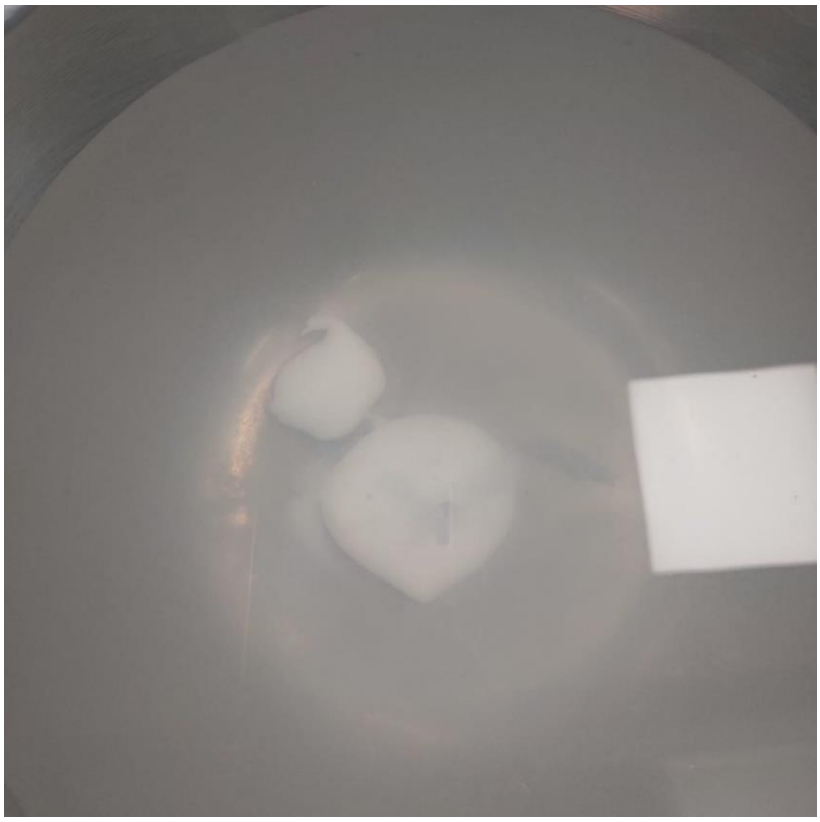

Fig. 11 Reverse spherification of mozzarella

The vinegar caviar spheres were simetrically round although they had different diameters. They were used to represent the dice numbers on top of the tomato gels. It had a sharp flavor with a fruity note that was in an appropriate balance with the rest of the plate. The spheres had a pungent smell and acidic taste.

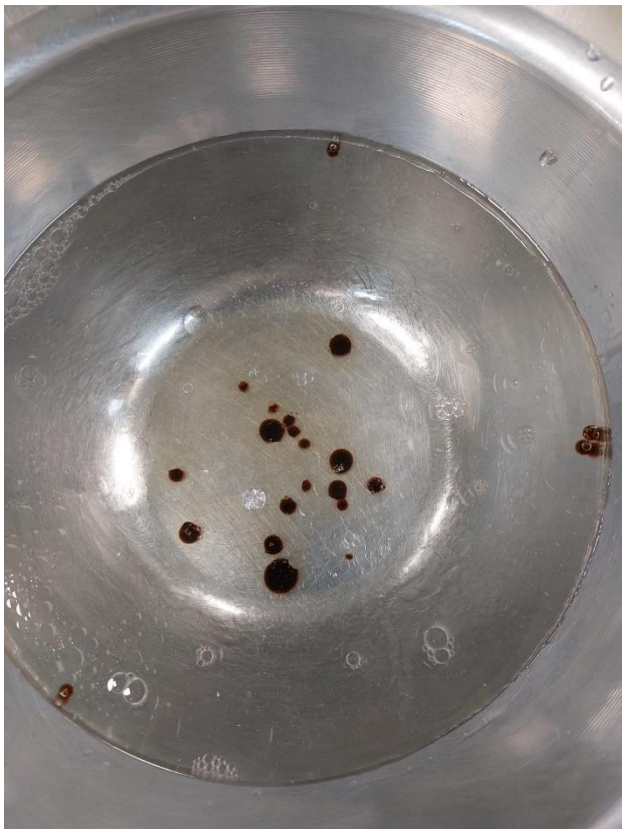

Fig.12 Vinegar spheres being rinsed

Encapsulated olive oil did not turn out as expected. The isomalt layer was not able to encapsulate the oil, which ended up spilling on the plate. The isomalt was transparent and colorless. It had a sweet taste but less sweet than sugar. Below is a photo of the expected desired result.

Fig. 13 Desired appearance of encapsulated olive oil

Source: Chef Studio

Fig. 14 The final dish presentation

Nbn element replicating basil did not make it to the final dish because of time restraint. However, it was supposed to be included in the dish in one of the two forms:

a) as a sauce which would be prepared after spooning and blending the gel.
b) as a gel cut in pieces shown in the photo below as part of the final plate from a previous experiment week where the gel was made using agar-agar, salt, water, green food colorant, basil flavor. More information is given in the logbooks, week 2 and week 3.

Fig. 15 The dish after the second week of the trials with green “basil leaves”

In the end, the specific attributes of each element of the dish were marked from 1 to 10 (1 being the lowest mark, 10 being the highest mark) regarding likeability and achievability. These points were given as approximate estimations from the comments of the academic lecturer, the fellow students who tried the dish and my own subjective evaluation during the four weeks of experiments. The marks are represented in the table below. A further sensory analysis should be conducted for accurate results.

	Texture	Color	Saltiness	Taste	Aroma	Realization of the original idea	Average
Tomato gel	**8**	**9**	**9**	**7**	**-**	**8**	**8.2**
Mozzarella spheres	**5**	**8**	**7**	**5**	**-**	**5**	**6**
Mozzarella dome	**7**	**8**	**7**	**7**	**-**	**7**	**7.2**
Vinegar caviar spheres	**7**	**9**	**-**	**6**	**7**	**8**	**7.4**
Encapsulated olive oil	**3**	**7**	**-**	**6**	**5**	**2**	**4.6**
Average of final dish	**6**	**8.2**	**7.6**	**6.2**	**6**	**6**	**6.68**

Table 1 Representation of the results with a grading system (1-10)

Discussion

The tomato gel had a firm texture and was a successful product, thanks to agar-agar. Agar-agar is a hydrocolloid derived from red seaweeds that is frequently used in the food industry as a gelling agent. Agar stands out among the hydrocolloids for its gelling power. High gel strength at low concentrations, low viscosity in solution, high transparency in solution, thermo-reversible gel, and sharp melting/setting temperatures are some of its principal properties *(Adams, 2019).* Since the original traditional dish is vegetarian, agar-agar was chosen to keep the same plant-derived source in NbN. Agar functions as a vegetarian substitute for gelatin and it is a common ingredient in Asian cuisine, where it is used as a gelling agent in the preparation of jellies, puddings, and custards *(Vega et. al, 2012).* Perhaps, the most useful property of agar in making the tomato gels is its hysteresis, which is difference between gelling/setting temperature (34-38°C) and melting temperature (85-95°C). This temperature gap keeps it stable at relatively high temperatures, differently from the rest of hydrocolloids *(Science of Cooking website, 2020).* Below is a photo showing the process of its production.

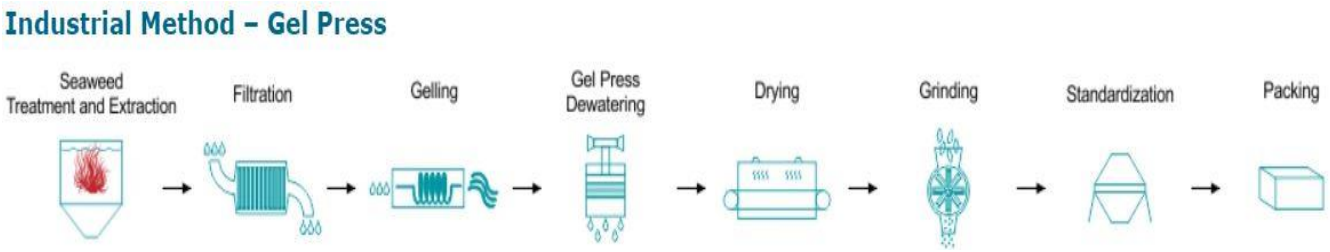

Fig. 16 Agar-agar production process **Source**: AGARGEL company

Tomato powder gives the gel its flavor essence. In its powdered form, tomato powder delivers a hit of pure tomato flavor, with all the bright, complex acidity you expect from tomatoes but concentrated in a powdered form. Tomato powder is produced by drying tomatoes and then finely grinding them. It is often made from tomato skins without the pulpy interior parts containing the seeds *(Alfaro, 2021).*

Reverse spherification utilizes a calcium source added to the edible liquid and is cooked in a sodium alginate bath. The calcium source can vary. Calcium chloride is probative for use in reverse spherification due to the bitter taste it imparts on the food. When alginates are applied from the cooking solution, typically thicker membranes are formed. Calcium chloride reaches maximum hardness after 100seconds, while calcium lactate takes 500 seconds and calcium gluconate takes well over 3000 seconds. Calcium chloride is the best option when the bitter taste can be hidden, while calcium gluconoate may be preferable for tailorable membrane thickness/hardness *(Lee and Rogers, 2012).* This method is more versatile than basic spherification and used with liquids high in calcium such as milk used to make mozzarella in this dish. Although sodium alginate can gel without the use of heat, calcium salts must be present in the media for this to happen. These gels do not return to their original state when heated, so they are thermo-irreversible *(Kitchen Theory, 2011).* However, the spheres were not strong enough on the plate. A possible reason is that the calcium lactate was not blended with a hand blender which did not allow it to be properly dissolved in the milk mixture. The presence of carrageenan may have impacted this too.

As for the mozzarella gel dome it was a stronger compared to the tomato gel. Except the refrigeration time, one factor to have an impact is the presence of kappa-carrageenan and calcium lactate. The color was well maintained aswell in difference to a previous recipe which used only kappa carrageenan and resulted in a transparent color. Titanium dioxide (E171) was used to restore the white color. However, in a recent European Food Safety Authority opinion, it was considered unsafe for food linking it to cancer (EFSA journal, 2021). Therefore, this additive

will be banned in EU from mid-2022 *(Food Safety Magazine, 2022)* so an alternative recipe was applied. Sodium alginate can form a gel without the application of heat, but calcium salts must be present in the medium for gelling to occur.

One of the key aspects of NbN cooking is preparation only from pure compounds or mixtures of compounds. Extra virgin olive oil is obtained from olives only through mechanical or physical means, under conditions that do not alter the composition of the oil. It is not a pure compound, rather it is a mixture of 98-99% triglycerides in the form of mostly monounsaturated fatty acids (oleic acid), significant amounts of polyunsaturated fats (linoleic and α-linolenic), and small amounts of saturated fats (palmitic by 7.5%–20% and stearic acid by 0.5%–5%). Tocopherols (α, β, γ, and δ-forms), sterols, polyphenols, pigments, hydrocarbons, aromatic and aliphatic alcohol, triterpene acids, waxes, and other minor components make up the remaining 1-2%, the unsaponifiable fraction, which ensures its excellent antioxidant activity *(Preedy and Watson, 2021).* Isomalt ($C_{12}H_{24}O_{11}$) is an odorless, white, crystalline, and low-hygroscopic substance. It tastes like sugar, but it is less sweet. In a 10% solution, its sweetening power is 50–60% that of sucrose. Isomalt blends well with many flavors, including fruity, menthol, and minty *(McNutt and Sentko, 2003).* Based on this, it was chosen in combination the olive oil fruity notes. Because it crystallizes slowly, isomalt is often used as a decorative material. Its high melting temperature makes it resistant to boiling, baking, and extrusion, while its low hygroscopicity allows it to be stored for lengthy periods of time *(Grembecka, 2019).* However, the isomalt layer was not able to encapsulate the oil. The most probable reason is that the isomalt was still too hot when the metal cutter was dipped in the pot, therefore isomalt was not solified and strong enough to support the weight of the oil which ended up spilling on the plate. Another attempt should be done with a more accurate food thermometer.

Balsamic vinegar is not a pure compound, rather it is a homogenous mixture as it is made from different compounds. It is made from the fermentation of ethanol (produced by prior alcoholic fermentation of glucose present in the grapes) into acetic acid carried out by acetic acid bacteria *(Helmenstine, 2019).* Balsamic vinegar contains 6% acetic acid, which is slightly more than distilled and apple cider vinegars. The rest its water and minuscule amounts of volatile compounds such as: ethyl octanoate, acetoin etc. *(WebMD Editorial Contributors, 2020).* To speed up the acidification process, modern commercial balsamic vinegars blend

concentrated grape must with wine vinegar. This vinegar is normally matured in huge oak barrels for 2 to 3 years *(Bauer, 2022).* The reason why the spheres had an evenly spherical shape during gellification is because a little time was allowed between boiling of the mixture and pouring them in the cold oil. This allowed for the mixture to cool down beforehand thus enabling the vinegar drops to jellify properly before reaching the end of the tall container.

Conclusion

In the wake of increasing global human population, food security issues and fight against climate change, Note-by-Note cooking is an interesting alternative solution to many sustainability concerns the world is facing in today's age. Being a young concept, it is confronted with various hurdles in its adoption by most of the society. This project intended to bring a traditional Caprese salad to a NbN version dish which was achieved to some degree. The main purpose of including fibers and dices in the final presentation was reached. Various techniques from Molecular Gastronomy were implemented. Due to some technical errors during preparation and the time restraint, the final dish was not on the quality expected prior to the start of the last week of experimentations. A detailed sensory analysis is recommended to be conducted in the future to receive more accurate feedback from the panelists and consumers in general.

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Logbooks

MODULE CODE: TFCS9025

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: __Uvejs Preza_____

FOOD PRODUCT: __ NbN Caprese Salad_____

WEEK NO.:___1____ **DATE:__28/03/2022____**

Weekly Aims and Objectives

Aim: Prepare two recipes of "tomato" gels with agar-agar (1%) and xanthan gum (0.5%)

Materials and Method (Ingredients, Equipment and Method)

Ingredients: 500ml water, 25g flour, 20g pea protein, 5g agar-agar, 5g salt, 2g tomato powder, 2g xanthan gum, food colorant (red)

Equipment: two mixing bowls, ingredient plastic containers, "Fisherbrand" precision weightscale, rectangular carton forms, pans, whisker, table spoon, plate, knife

Method: Two recipes were made using two hydrocolloids: agar and xanthan gum. The ingredients lists of the recipes are as follows:

1) 200ml water, 20g baking flour, 15g pea protein, 2g agar, 1.2g tomato powder, 1g xanthan gum, a pinch of salt (approx. 1g), two drops of food colorant (approx. 2ml)
2) 20ml water, 2g agar, 1g xanthan gum, two drops of food colorant (approx. 2ml)

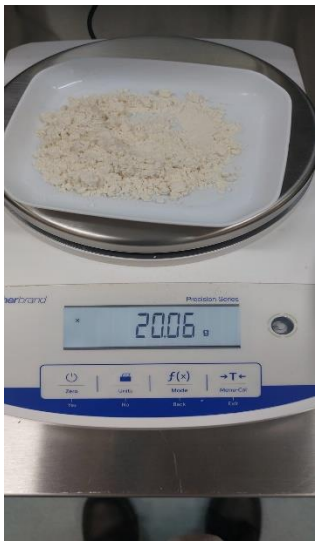
Pea protein

Tomato powder

Agar-agar

200ml water was weighed and then poured in a bowl. 20g baking flour and 2g agar were added and mixed with a spoon until dissolved. Then 15g pea protein, 1.2g tomato powder, 1g xanthan gum and two drops of food colorant were added and whisked until a homogeneous mix was obtained. This mixture was poured in a pan and heated until simmered. A pinch of salt was added. The mixture was continuously stirred for 1-2 minutes to activate the agar. Following, the mixture was poured in rectangular shapes and then put in the freezer on -20°C for 30minutes. A second shape was kept in the freezer for only 20minutes.

The second recipe had the same procedure with its respective ingredients.



Weighing the flour

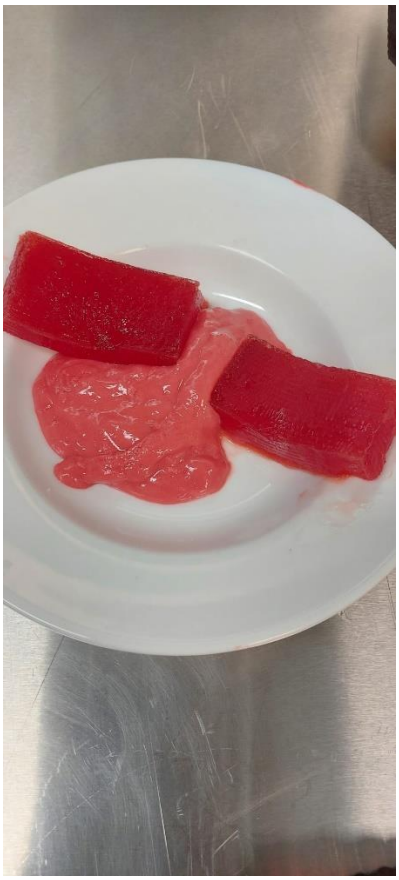
Adding the colorant

Results and discussion

First trial result was not satisfying. The structure was not strong enough to bind all the water and it got dissolved after being put in a plate. This may happen because of the interaction between pea protein and the water not allowing agar to bind water and form a proper gel. In the photo it is visible that the structure fell apart as a thick liquid after being plated.

The second trial was successful in creating a strong gel with a chewy texture. The consistency of the gel makes agar very effective to use for this assignment which requires cube shapes. Also the high content of agar in fiber (95%) makes it the perfect hydrocolloid to fulfil the requirement of fiber content.

However both recipes lacked significantly in flavor and taste which was not a surprise since no flavour compound was used in either of the trials. Next week tomato, basil and other herbs flavours will be added to the trials.



The first trial after freezing step

The difference: 1st trial (dark red) & 2nd (light pink)

Conclusions

- Pea protein and baking flour are not a good mix with agar as the consistency of the final product was not good. The gel did not have a strong water-binding activity.
- Continuing to use agar as the main hydrocolloid but experiment again on its activity alone without including xanthan gum.
- The color was satisfactory to both of the trials but the 2nd trial was closer to the true color of tomato.

Recommendations for following week.

- Adding flavors to the agar gel as it will give it a more pleasant acceptable taste.
- Adding more tomato powder or salt to the gel.
- Try making a mozzarella ball or cube by reverse spherification using whey and casein powder.
- Introducing balsamic vinegar to the recipe.

Ingredients required for the following 2 weeks.

500ml water, 10g casein powder, 10g whey powder, 5g agar-agar, 5g salt, 2g tomato powder, 2g xanthan gum, food colorant (red)

MODULE CODE: TFCS9025

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: __Uvejs Preza_____

FOOD PRODUCT: __ NbN Caprese Salad_____

WEEK NO.:___2____ **DATE:__01/04/2022____**

Weekly Aims and Objectives

Aim: Prepare a prototype plate of "tomato and basil" cubes

- Design and put together three recipes
- Develop trials using agar-agar gelling and direct spherification technique

Materials and Method (Ingredients, Equipment and Method)

Ingredients: 1L vegetable(sunflower) oil, 500ml water, 270ml balsamic vinegar, 5g agar-agar, 5g salt, tomato flavor, basil flavor, 10g tomato powder, food colorants: (red) (green)

Equipment: two mixing bowls, ingredients plastic plates, “Fisherbrand” precision weightscale, rectangular carton forms, pan, whisker, strainer, spoon sieve, table spoon, plate, knife, tall container, cling film wrap

Method: Three recipes were made using one hydrocolloid: agar-agar. The ingredients lists and the preparation procedures of the recipes are described below:

3) 150ml water, 25g sugar, 5g tomato powder, 2g agar, two drops of red food colorant (approx. 1ml), one drop of ripe tomato flower

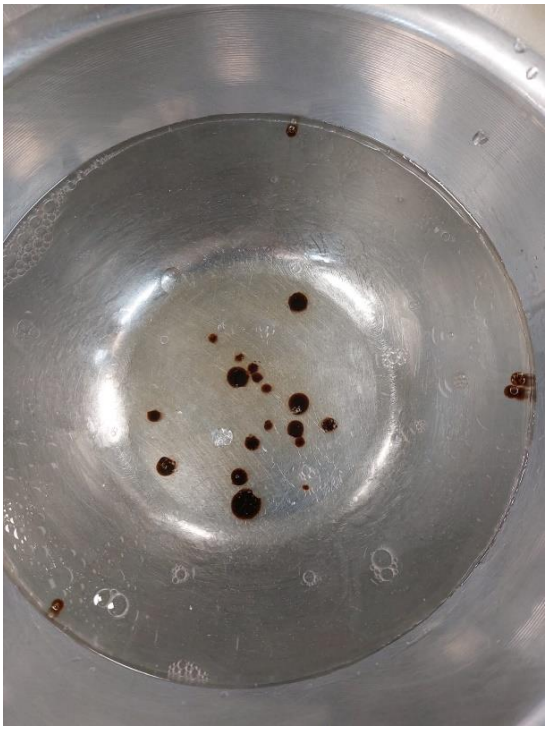
- All the ingredients were weighed and then mixed in a bowl with a whisker until a homogeneous mixture was achieved. The mixture was poured in a pan and brought to a boil. It was continuously stirred for 2minutes then removed from the gas hob. After letting it cool down for a few seconds it was put in the the form and refrigerated for 30minutes at 4.6°C.

4) 102.76ml water, 2g agar, a pinch of salt (approx. 1g), two drops of green food colorant (approx. 1ml)

- In the same procedure as the first recipe all the ingredients were mixed, boiled, and then put in the form. But this recipe was wrapped in cling film and freezed at -20°C for 10minutes.

5) 1L sunflower oil, 261ml balsamic vinegar, 2g agar

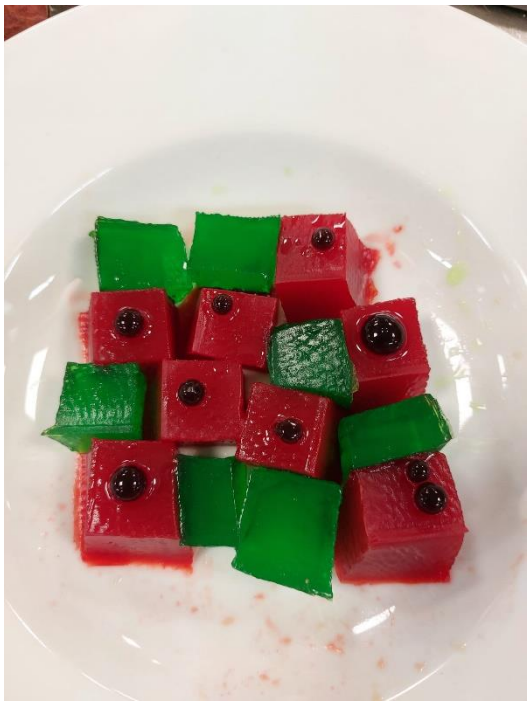
- 1L of sunflower oil was poured in a tall container then placed in the freezer for 1hour and 20minutes. 5minutes before oil was taken out of the freezer, in a pan vinegar and agar were added and boiled for 2minutes. Then using a syringe, vinegar mixture was streamed in the cold oil in droplets. After being fully submerged in oil for 1-2minutes, the spheres were taken out using a spoon sieve and rinsed in a cold water bowl nearby.

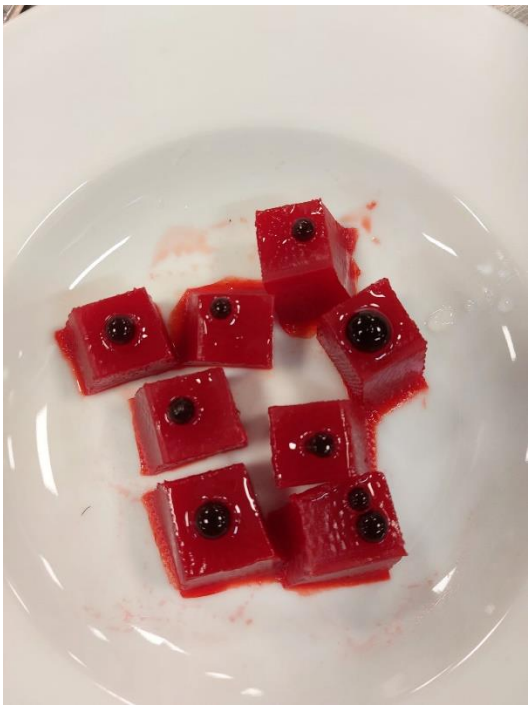


Results and discussion

- After the first two recipes had been finished, they were taken out of their forms, cut into cubes and placed in the plates mixing the colors. Then in top of some of the cubes, vinegar spheres were placed.

The plate was nicely arranged and the taste was appreciated by the students who tried it. Different people preferred different recipes. For me, the “tomato” cubes were the tastiest. The vinegar spheres had nice round shapes but were too strong and acidic in flavor.





The final plate was labelled and stored in the fridge until next week. The remaining gel parts from the recipes which were not placed in the plate, were also stored and can be used in order to make plating design in the future.

Conclusions

- The final dish was successful. It had an appetising look with attractive colors and an acceptable taste.
- The process to make vinegar spheres was a bit long because the oil needs to be frozen for more than an hour. It would be time-saving to have it pre-frozen and ready to use when the experiment classes begin.
- The gel parts that were not used can make an interesting plating design base.

Recommendations for following week.

- Dilute the vinegar mixture with water in order to give the spheres a less acid flavor.
- Introducing mozzarella balls or cubes to the dish. Making trials with carrageenan and using reverse spherification to achieve the final product.
- Trying to bring olive oil in an innovative way by encapsulating it with isomalt.

Ingredients required for the following 2 weeks.

500ml water, 270ml balsamic vinegar, 20g whey powder, 20g casein powder, 10g tomato powder, 10g isomalt, 5g agar-agar, 5g salt, 3g calcium chloride, 3g iota carrageenan, food colorants: (red) (green) (white), tomato flavor, basil flavor, mozzarella/milk flavor

MODULE CODE: TFPD9022

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: __Uvejs Preza_____

FOOD PRODUCT: __ NbN Caprese Salad_____

WEEK NO.:___3____ **DATE:__04/04/2022____**

Weekly Aims and Objectives

Aim: Complete the dish by introducing mozzarella

- Use kappa carrageenan and reverse spherification technique to make “mozzarella” cube
- Introduce dietary fiber in the agar gels
- Use the stored gels from last week to make the plating design

Materials and Method (Ingredients, Equipment and Method)

Ingredients: 500ml water, 25g milk powder, 10g tomato powder, 5g dietary fiber, 5g agar-agar, 5g salt, 5g calcium chloride, 5g kappa carrageenan, 2g titanium dioxide, food colorants: (red), tomato flavor, mozzarella/milk flavor

Equipment: two mixing bowls, ingredients plastic plates, “Fisherbrand” precision weightscale, rectangular carton forms, pan, whisker, round metal cutter, syringe bottle, silicon mat, tablespoon, plate, knife

Method: Three trials were prepared using two hydrocolloids: agar-agar and kappa carrageenan. The ingredients lists and the preparation procedures of the recipes are described below:

1) 201.2ml water, 5g dietary fiber, 5g tomato powder, 2.14g agar, two drops of red food colorant (approx. 1ml), one drop of ripe tomato flavour, pinch of salt
All the ingredients were weighed and then mixed in a bowl with a whisker until a homogeneous mixture was achieved. The mixture was poured in a pan and brought to a boil. It was continuously stirred for 2minutes then removed from the gas hob. After letting it cool down for a few seconds it was put in the the form and refrigerated for 45minutes at 4.6°C.

2) 150ml water, 3 tablespoons (25g) milk powder, 2.5g kappa carrageenan, 0.5g titanium dioxide

- In the same procedure milk powder was mixed with water which was added bit by bit in small amounts and stirred again. A total of 169ml milk was gained.

After adding kappa carrageenan at 1.5%, the mixture was boiled for 1-2minutes and then taken off the gas hob. However it was noticed that it was transparent. To correct this and give a milky white color, titanium dioxide was added in a very small amount. After boiling again for 1min it was poured in a form and refrigerated for 40minutes. No salt was used in this recipe.

3) 171.8ml water, 3g kappa carrageenan, 3g calcium chloride.

- This recipe was also intended to form mozzarella ball but from a different mixture of ingredients. The above ingredients were whisked and the mixture went straight to the forms without boiling it first. It was refrigerated for 1hour at 4.2°C.

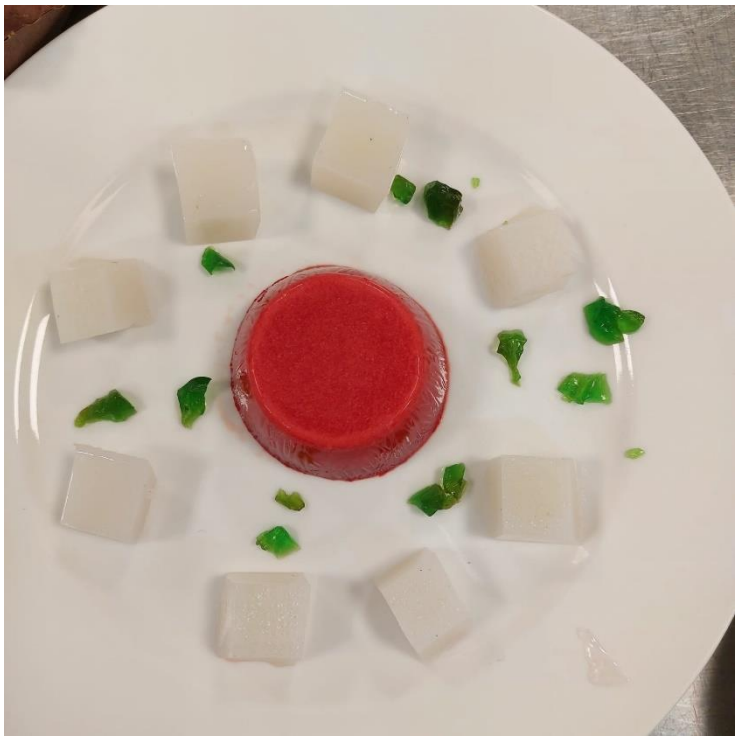
Results and discussion

All three recipes were taken out of the fridge approximately at the same time and were examined for plating. The first gel “tomato” was satisfactory in terms of look, gellification and taste. This was confirmed by the other students who tried it.

The second recipe (mozzarella with milk powder) was satisfactory in terms of look but the set gel was too strong. Probably the setting refrigeration time was too long which should be reduced. In terms of taste, it was lacking because no salt or specific flavor compound was used in its preparation.

The third recipe (mozzarella with carrageenan+$CaCl_2$) was not gelified. It was still a liquid. This is maybe because it was not boiled or the kappa carrageenan does not act well with calcium chloride. So this recipe was discarded and not used at all in the final plate.

For the final plate, basil gels from last week were also used. They were chopped in small pieces and used for decoration. However a better way to use the gels would be as a sauce. A way to do that would be to blend the set gels until they reach a smooth liquidy texture. Overall, the plate was well liked although it still needs modification for next class.



Conclusions

- The final dish was satisfactory. It had an interesting design and an acceptable taste.
- The basil gel parts will be used as a sauce for the design of the plate to bring more variety to the structures used in the dish.
- For the mozzarella balls milk powder will be used, but the setting time should be shorter. Also, an experiment using iota carrageenan may happen because it might give a better final result than kappa carrageenan. A proper flavor should be found and mixed in the gel preparation.
- The tomato gel was successful and will be continued to be used to future preparations.

Recommendations for following week.

- Trying to bring olive oil in an innovative way by encapsulating it with isomalt. An experiment with it was thought to be conducted this week but because of time restriction, it was not possible.
- Making a trial by using reverse spherification to produce mozzarella balls as the texture of that process is very similar to the actual traditional product texture
- Finalise the dish by bringing all the ingredients and elements of the plates from the previous weeks.

Ingredients required for the following 2 weeks.

500ml water, 270ml balsamic vinegar, 25g whey powder, 10g tomato powder, 10g isomalt, 5g agar-agar, 5g salt, 5g iota carrageenan, 5g kappa carrageenan, 2g titanium dioxide, food colorants: (red) (green) (white), tomato flavor, basil flavor, mozzarella/milk flavor

MODULE CODE: TFPD9022

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: __Uvejs Preza_____

FOOD PRODUCT: __ NbN Caprese Salad_____

WEEK NO.:___4____ **DATE:__25/04/2022____**

Weekly Aims and Objectives

Aim: Finalise the dish by bringing all the ingredients and elements of the plates from the previous weeks.

- Introducing extra virgin olive oil in an innovative way by encapsulating it with isomalt.
- Making a trial by using reverse spherification to produce mozzarella balls.
- Prepare “caviar” vinegar spheres with white vinegar+colorant.

Materials and Method (Ingredients, Equipment and Method)

Ingredients: 500ml water, 250ml balsamic vinegar, 30g skimmed milk powder, 25g tomato powder, 10g isomalt, 10g agar-agar,10g dietary fiber, 5g salt, 5g kappa carrageenan, food colorants: (red) (green) (black) tomato flavor, basil flavor

Equipment: two mixing bowls, ingredients plastic plates, “Fisherbrand” precision weightscale, rectangular carton forms, pot, whisk, strainer, spoon sieve, tablespoon, plate, knife, tall container, syringe, squeeze bottle

Method: Five recipes were produced using different hydrocolloids. agar-agar. The ingredients lists and the recipes preparation methods are described below:

1) **Tomato cubes:** 200ml water, 5g tomato powder, 3g dietary fiber, 3g salt, 2g agar, two drops of red food colorant (approx. 1ml), one drop of ripe tomato flavor

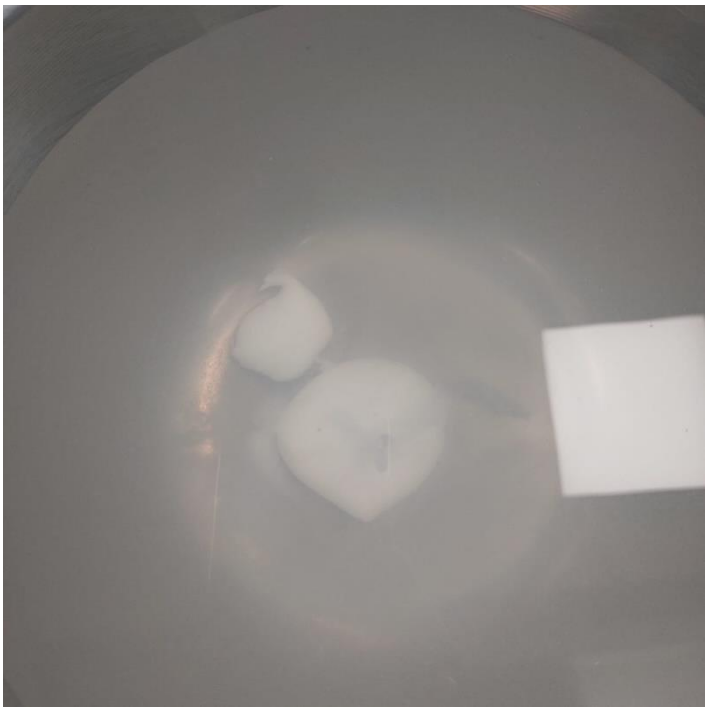
- All the ingredients were weighed and then mixed in a bowl with a whisker until a homogeneous mixture was achieved. The mixture was poured in a pan and brought to a boil. It was continuously stirred for 2minutes then removed from the gas hob. After letting it cool down for a few seconds it was put in the the form and refrigerated for 40 minutes at 2.8°C.

2) **Mozzarella balls (reverse spherification):** 150ml water, 30g skimmered milk powder, 3.7g calcium lactate, 1.8g kappa carrageenan **;** 500ml water, 2.5g sodium alginate

- Water and milk powder were added in a bowl and whisked until “milk” was achieved. Calcium lactate and kappa carrageenan were added whisked for 20seconds. In a separate bowl water and sodium alginate were added to make an alginate bath. It was blended with a hand blender for 30seconds. The mixture was poured in a food-graded polyethylene bag which was put in the vacuum machine to remove the air bubbles in the mixture which can interfere with the spherification process. After vacuuming the mixture was poured in a clean bowl. Another bowl was filled with plain tap water. With the help of a spoon, the “milk” mixture was poured in the alginate bath where it was gently stirred to prevent the spheres from sticking together and left for 4minutes to gellify. 3 spheres were obtained.

3) Mozzarella gel dome:

- The remaining part of the “milk mixture” was poured in a pan and brought to a boil for 1min. After letting it cool down for a few seconds it was put in the the trapezoid form and refrigerated for 25 minutes at 3.2°C.

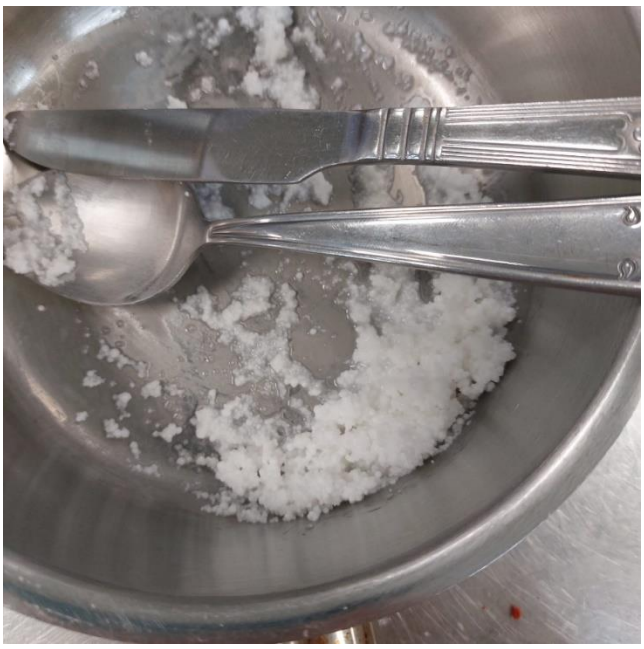


4) Balsamic vinegar “caviar” spheres:

200ml balsamic vinegar was mixed with 50ml water. 2g agar-agar was added and the mixture was whisked. Then it was poured in a pan and brought to boil for 1minute. Afterwards the mixture was left aside to cool. Stored neutral vegetable oil from the last week, was taken out of the freezer. With the help of a syringe, the vinegar mixture was streamed in droplets into the cold oil. The droplets started forming spheres and after 1min they were strained out of the oil using a slotted spoon.

5) Encapsulated olive oil: 15g isomalt, 10ml olive oil, 5ml water

- Isomalt was mixed in a pot with a small quantity of water, enough until it looks like wet sand. It was heated on medium-low heat and until it started to bubble. The mixture was removed from the gas hob and set aside to cool. The olive oil was poured in a squeeze bottle. The isomalt on the bottle was measured with a thermometer and when it reached 140 degrees C, a round metal cutter was dipped in the pot. A thin layer of isomalt was formed around the mold base and on top of this base olive oil was poured by using the squeeze bottle. The olive oil drops down encapsulated by the thin layer of isomalt.



Results and discussion

- The tomato gel cubes and mozzarella dome were the most satisfactory ingredients of the final dish. Their structure was well achieved and the color was appetising.
- Part of the tomato gel was cut in random shapes (eg bird on top of mozzarella dome) and was used to add decoration to the plate.
- The mozzarella balls formed by reverse sperification technique took the largest amount of time to prepare. The final product did not have the right thickness and it was liquidy quickly after putting it on the plate. The membrane encircling the liquid was not strong enough. A part a reason for this is the calcium salt not properly dissolving in the mixture during the preparation phase. A hand blender should have been used same as in the alginate bath preparation.
- The “caviar” spheres were well achieved and their taste was more acceptable and less acidic than some weeks ago. The reason is that vinegar was diluted with water 4:1 compared to the first time when only balsamic vinegar was used.

- The biggest ingredient to work on is the encapsulated olive oil. The isomalt layer was not able to encapsulate the oil, which ended up spilling on the plate. The most probable reason for this is that the isomalt layer was still too hot when the metal cutter was dipped in the pot, thus isomalt was not solified and strong enough to support the oil weight. Another attempt should be done in a separate trial plate or a silicon mat prior to placing it on the final dish, in order to avoid similar spills.

- Running out of time was a main reason that some ingredients were rushed and not properly presented in the final dish.

Conclusions

- The final dish was not on the quality standards expected prior to the class. It lacked some elements such as basil green sauce for plating or basil cubes in order to complete the dish.
- The olive oil did not encapsulate inside the isomalt layer. Additional attempts should be conducted when the temperature of the layer is lower.
- The dish intended to bring a traditional Caprese salad to a Note-by-Note version and it achieved to do so up to a certain point.
- A sensory analysis was not carried out.

Recommendations for following week.

- This was the last week of this module so there will not be more experiments but the recommendations for future preparations were described above. Further on, a sensory analysis should be conducted aswell.